The paper is an outline of work done from 1977-1979 by the authors, as visiting scientists at the Charles Darwin Research Station in the Galapagos Islands, Ecuador. They were funded for three years by the WWF (World Wildlife Fund)and the Bird Preservation Society of UK to study the breeding biology and ethology of Flightless cormorants and the Greater Flamingo. The presentation includes human aspects of living on and travelling between uninhabited islands.

It will introduce the concept taken from sports psychology, of "staying in the zone of peak academic performance " in order to accomplish the task of obtaining a university degree whilst at the same time ensuring physical and psychological health. The zone of peak performance is defined as the ideal psychological and physical state commensurate with a level of optimum attainment for a particular individual.

Finally strategies used by therapists to assist student to continue successfully in their course of

LIVING SCIENCE: THREE YEARS IN THE GALAPAGOS ISLANDS

On Fernandina Erupting
August 1978
Fernandina!
Again you awake from your restless sleep
To remind mankind of your power.
"Respect planet earth, with its secrets to keep.
Descend from your ivory tower"
With clouds of crimson, mushroom in shape,
And cinders of gold with fire in their wake.
The night cannot be while you shudder and shake.
The whole sky reflects like a glorious day break.
The heat from you cauldron sizzles the lake.
The red sinuous lava glides down to its fate.
Pay heed to its message man before it's TOO LATE.

In this bicentennial anniversary of Charles Darwin's birth 2009, it seems appropriate to examine aspects of Darwinism that impinged on my decision to travel to the Galapagos Islands, in 1976 and spend some time on the Island of Fernandina described in the poem.

Darwin spoke of "reproductive fitness" prime examples of which are the peacock's tail or the bower bird's colourful collection which are attractive to a potential partner. My partner's "peacock's tail" equivalent was an invitation to travel on an adventure to the remote Galapagos archipelago and to study at the Charles Darwin Research Station for a few years.

I needed little coaxing to accept this opportunity to see a new part of the world, having worked for 16 years as a high school teacher. In those years I had travelled widely usually with a coterie of teenagers or sports team players in tow. Having taught geography for many years I had a passion for exploring the world.

We began our preparations from Adelaide, South Australia where we lived, and managed to obtain basic camping and photographic equipment locally. At that time there was little in the way of high tech. equipment that so many visitors to the islands today can avail themselves of. Our camping experience was going to be fairly rough, even primitive.

We travelled from Sydney to Los Angeles and then on to Quito the capital of Ecuador, high up in the Andes. From Quito we took a local flight to Guayaquil a large coastal port slightly south of the equator. We then flew to Baltra, a small island in the Galapagos which served as a US air base during World War II. The runway has continued to be the gateway to the islands by air and thousands of tourists now use this airport every year.

Our destination was the village of Puerto Ayora on the southern coast of the Island of Santa Cruz. At this time the village was small and had no cars except the jeep used by the Charles Darwin Research Station. The CDRS was established in 1959 the

centennial of the publication of Darwin's Origin of Species and was supported by UNESCO and the Charles Darwin Foundation.

We were well received by the Director of the Research Station, Craig Mc Farlane and his wife Jan. We stayed in the simple CDRS accommodation for visiting scientists, on the research station site. Bob with an agonising look on his face said "Liz. What have we done?". The reality of the situation had hit him and he was numb for a couple of days. The shock of arriving in this primitive place needed time to absorb.

My initial role was to be librarian at the scientific library and to catalogue new books and research papers as they arrived, using the Dewey system. All books were housed in a humidified room which kept the air and humidity constant. My second role was to work as my partner's Research Assistant on field trips to all the islands.

For the next three years we lived on a World Wildlife Fund Grant and a small stipend from the Bird Preservation Society of Great Britain. Within a week or so we moved into our own single roomed lava stone cottage on Pelican Bay in the adjacent village of Puerto Ayora.

Our main brief was to add to the knowledge base to assist in the survival of certain sea birds especially the Flightless cormorants and the flamingos. We needed to gain a familiarity with the islands and an understanding of bird populations and distribution. Bob had already spent two years as a guide and was familiar with some islands and popular tourist spots.

Our first inter-island trip was on the small National Park boat, the Gaviotin (seagull). It was sailing south eastwards toward the distant island of Hood, the home of the magnificent Waved albatross. The Skipper did not anticipate the size of the seas on that trip as the South East trade winds stirred up the ocean and the tiny Gaviotin was buffeted in all directions. It plunged from prow to stern whilst rocking from port to starboard. I recalled that Darwin had very poor sea legs and suffered when travelling at sea. I too was violently ill with sea sickness and the others on board were suffering to a lesser extent. We decided to drop anchor at the island of Barrington until the wild conditions eased, before finally returning "home" to Academy Bay on the island Santa Cruz. This was a very challenging initiation to ocean storms, for me. No trip could be as bad as this I thought. I anticipated that the seas would be less wild on future trips.

THE GAVIOTIN (Seagull)

Voyage from Santa Cruz to Hood Island.

The bravest boat that I have known
Took on the stormy sea
And battled bravely to the south
With crew and Bob and me.

The Trade winds roared as we advanced
Through towering waves around.
The tiny boat bobbed like a cork
Whilst braced for every pound.

The fear had gripped us part-time tars
Whose sea legs weren't too strong.
While scuppers flooded with cruel waves
WE CHUNDERED HARD AND LONG.
Elizabeth Tindle (2009)

Our next exploratory trip was to the island of Tower which was almost diametrically opposite to Hood Island, to carry out a bird census on three types of boobies (Sulidae) and frigates. A young Ecuadorian scientist and two students from the Catholic University accompanied us. The latter were nuns studying their doctorate in biology. Leonado Maldonado's concern for my welfare was obvious. He repeatedly said "Cuidado Liz" which I quickly learned meant "Be careful Liz". The terrain was unbelievably inhospitable and one false move might have meant a twisted ankle or a gash on the limb. We landed in Darwin Bay and camped close to the beach and to colonies of nesting pelicans, boobies and gulls. Darwin Bay is a collapsed crater similar to Wellington harbour in New Zealand. The raucous noise of the birds was with us night and day.

NAPOLEON THE MARINER

We hired a boat to take us north
To stay on tiny Tower
An island standing like a gem
Midst the Pacific's Promethean power.

We stepped aboard the vessel's deck
Student nuns, and us
The Patron then appeared himself
Napoleon made no fuss.

We'd played a game of basketball
A week or two before
Napoleon was on the Mariner's team.
Their demise for him was raw.

We settled in for three days sail
We anchored every night
When told there were no loos on board
The nuns got such a fright.

The strain was seen in every face
A tension had descended
We searched the horizon for a glimpse of land
Until the voyage ended.

Soon we sighted Darwin Bay
A broad caldera lake
A cheer rang out "Land ahoy"
Thank God it wasn't a mistake!

We disembarked and set up camp
Beside a lagoon so blue
While seabirds watched
And screeched their calls,
We farewelled Napoleon's crew.

It was now time to find the flamingos that had started nest building on the island of Isabela on a brackish lake near the village of Villamil. Isabela is the largest of the Galapagos Islands and comprises five volcanoes joined at their bases by lava flows. Each crater has evolved its own sub-species of giant tortoise as have each of the other islands. Villamil was named after the founder of the first colony on the Islands in 1832, three years before Darwin visited. It was used as a penal colony until the mid fifties. Because of human habitation, the island has many wild cattle (they were introduced as a beef export) and wild burros. Donkeys were used to transport sulphur from the craters to the coast for export. There are also packs of wild dogs from prisoner days as well as destructive pigs.

We left Puerto Ayora on a hired fishing boat loaded with our supplies including fresh water, for two months work in the field. Camp food was basic and was purchased at the only village grocery store. On one trip we were given 35 packets of asparagus soup.

When we arrived in the port of Villamil we were met by Sr. Tupiza who worked for the National Park. We loaded everything on donkeys and headed for Lake Cementario where the flamingos had started nesting in the middle of the lake. These shy birds tend to build their mud mounds in out of the way places for safety from predators including humans. They choose their location based on the friability of the mud and the amount of water available although they do not necessarily feed in the same lake in which they nest.

Lake Cementario was composed of deep slimy mud in which it was difficult to move. We needed some form of transport to convey us across each day. We scoured the nearby beach for drift wood and found a few logs of balsa which we bound together with dowels and lianas to create a rough but utilitarian raft. Complemented with two rough oars we had our environmentally friendly transport. Bob decided that he would wade across in his wet suit for each observation and clean up in the nearby ocean afterwards.

Alongside the lake was a small cemetery which gave its name to the lake. It added a spookiness to the night time trips by the light of the moon in the silence of the night. Bob waded across the lake in the deep mud for his daily observations. I used the makeshift raft.

The best observations were made in the early hours of the morning when there was a full moon. At that time the adult flamingos flew in to Cementario from neighbouring lakes where they had been filter feeding mainly on copopods. They arrived to feed their single chick or to relieve their incubating mate on the nest. Mutual recognition was by calling. The adults have a trumpet like honk, lower in the male than the

female. This communication starts when the flamingo chick is in the egg. The parent stand from the nesting position periodically concentrates on its egg and turns it whilst simultaneously calling. It is believed that the almost hatched chick responds even when still in the egg. It uses an egg tooth to assist in cracking the egg when ready to hatch.

As I sat on my log in the middle of the mangrove, I could see the colony of twelve nests and pairs clearly. The chick that is first to hatch has an advantage in the colony as all other chicks defer to an older chick. One can easily understand where the expression “pecking order’ originated.

From day one these chicks are precocious meaning that they can walk and get around without a parent. Observations have been made on the African plains of thousands of flamingo chicks in a phalanx with a few adults scattered on the periphery. It was believed that an adult fed any chick as it would be impossible to identify one’s own. This has been disproved as they all have their distinctive voice and smell. The young chicks squabble whilst they wander around ingesting what appear to be large clumps of thick mud. Mud contains vital trace elements, nutrients and minerals valuable to the healthy growth of the chick. Initially when the chick is tiny it receives “breakfast in bed” that is it is tucked under the parent’s wing with its head poking out and the parent disgorges a rich red fluid into the grasping beak of the chick. The feeds are then delivered in a standing position with both chick and parent facing in the same direction. The rich oil continues to be produced and pumped out into the chick. The speed of the pumping action becomes more rapid and the length of the feed increases as the chick grows and changes from a white fluffy chick to a dirty greyish adolescent. Occasionally the bright fluid can be seen trickling down the dusky surface of the chick’s plumage.

When the meal is over the adult may forage around for a while and usually leaves the breeding colony. During the early daylight hours adult birds are fairly active and are involved in a number of feeding activities. They feed on copepods, algae and other microscopic organisms by filter feeding. The carotene in their diet gives them their deep pink colouration. They spend most of the hotter hours of the day standing around in small groups sleeping.

After a number of weeks doing daily observations of the breeding site on Lake Cementario we decide to check another lagoon some twenty five miles south of our present camp site. This lagoon is known as Quinta Plays (Fifth Beach) and is quite important for observing the feeding and courting behaviours of the flamingos.

Senior Tupiza organised for us to have available three burros to carry all of our camping gear, water, cooking equipment and food for a few weeks’ stay. He also decides to accompany us with a loaded rifle because the area is notorious for having packs of wild dogs and pigs.

We begin our journey walking through a dry cactus and cryptocarpus zone and stay close to our loaded donkeys. We suddenly come across a huge volcanic rock wall built in the middle of nowhere for no apparent purpose. We are informed that this is known as “el muro de los lagrimas’, the wall of tears and was constructed by the prisoners of the Villamil penal colony as an activity to keep them occupied or maybe

for punishment. We continue our journey through parched country staying alert to any dangers. Without any warning our leading donkey starts running into the adjacent undergrowth and disappears from sight. He is loaded with tent, utensils and bags and leaves a trail of camping equipment en route as he forces his way through the bush. It appears that Neddy our donkey has caught the scent of a female burro in heat and nature got the better of him. I take care of the remaining two donkeys while Bob and Tupiza go off in hot pursuit of the offending animal. In time they return pulling Neddy minus his load. We reclaim what we can find and tie it to the pack animal before continuing our long walk to Quinta Playa.

We set up another camp at Quinta Playa and inspect the nearby salt water lagoon. About twenty flamingos are in the throes of their ostentatious courting displays. They all appear to be cognizant of what the others are doing in the varied movements of their courting "dance". In unison they surge in one direction and then in a split second turn and change the direction in which they advance. They proceed to go through a routine of automatic movements which includes "broken neck" action where they all bend their elegant necks at once; wing salute with a flash of black wing feathers, then they quickly move their bill from left to right repetitively. Some of the flamingos start pairing off, the male approaches the female from behind, she puts her head in the water and he is on her back for a brief time before jumping off into the water in front of her.

We were as thrilled to see this courting dance as we were to discover at a later date that not only do the parents gradually lose much of their colour during the breeding season but they also might lose their ability to fly as some of the prime wing feathers are lost at moulting.

Flamingoes

Elegance in feathers, slender and sleek,
Bird of breathtaking beauty
Of what do I speak?
It is the famed flamingo
With its unquestioned mystique.

Its grace as it glides through lake or lagoon
Is matched by its motion in flight,
Seen in silhouette on the face of the moon,
When it travels the islands by night.

It migrated long past, to these distant isles,
The Caribbean or Bonaire was its home.
Or was it by chance that it came all these miles
Not more the wide world to roam.

With "broken neck" or "wing salute"
Its dance of courtship passes.
There's no one who would dare refute,
That this all scenes surpasses.

With necks erect and flagging bill,

They surge along as one.
Their rosy array adds more colour still,
Into the gold setting sun.

Elizabeth Tindle, 1976

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After our work at Villamil, on the Island of Isabela, we make a trip to the Island of Santiago to an area commonly called Mina de Sal or Salt Mine as it is the spot where historically a small salt exporting industry operated.

The two fishing boat crew members help us unload our equipment using pangas with small outboard motors to enable us to get on shore. The flamingos are nesting in the crater lake of a nearby volcano. We set up our tent at the base of the volcano near to the beach and each day we walk the 30 minutes or so up the volcanic track for each observation. We generally take our spot from a cave entrance frequented by wild goats. From here we can look down on to the panorama of the crater and witness the activity of the nesting flamingos. They have built their nests on muddy islets in the centre of the crater-lake.

After some weeks a rare event occurrs. It starts to rain. We're ecstatic. The heavens open and it pours. We make sure that every saucepan, cup and container is placed to collect the precious drops. We strip off our clothes and stand in our birthday suits and soap up to have a delicious fresh water shower. Even in the village we have only cold brackish water for washing. As the rain continues we build trenches around the tent to prevent flooding but everything becomes saturated and we have to wear wet clothes for some time.

Meanwhile up in the crater the the level of the water in the lake is slowly rising. The flamingos are becoming inconvenienced as the shape of the crater means that it acts as a funnel. The incubating birds are sitting in water that covers their nests. Their precious eggs are eventually washed away and the nests have to be abandoned by the birds. It is an unsuccessful breeding attempt.

It is not only the flamingos that were struggling. I find that my face and lips are bloated and swollen and my whole body is covered with red rashes. I itch. In fact all of my body has swollen and every time I try to stand up, I faint. We realised later that it was an allergic anaphylactic response to something I had eaten. This is dangerous especially as I am in the early stages of pregnancy. Realising the seriousness of this, Bob decides that he had to look for help. We have no boat, no radio nor any way of contacting the outside world. Bob trekks along the coast, high on the cliffs, scouring every inch of the horizon to see if he can spot a boat of some description. After some considerable time he eventually sees a small yacht on the horizon. He exuberantly begins waving his arms and he work hard on trying to attract their attention. Amazingly he does. The yacht sails toward the coast of Santiago and sends a panga to the beach. There are two American nurses on board. The last I remember is trying to

stand up to walk with them to the boat. I pass out and they carry me fireman's lift style to the beach. I regain consciousness when the cold water of a wave breaks over me. That is the end of our observations on Mina de Sal for a while. The yacht sails toward Puerto Ayora and arrives a day and a half later. Thankfully the doctor has some antihistamines to inject in my muscles and tissue and I recover fully after a couple of days in the small village 'hospital'.

Between each research trip to the islands we return to Santa Cruz and I resume taking care of the Research Station library. On one of these return visits the newly released book of Richard Dawkins, The Selfish Gene (1976), is on the desk awaiting cataloguing. It was at this time that I read it avidly. This book has made a deep impression on me as it has on many others.

Our next foray into the wilds to follow the breeding of the flamingos, is to Santiago once again. This time the birds are establishing a breeding colony on another part of the coast at a location known as Sarten which is Spanish for frying pan, presumably because of the round shape of the coastal lagoon.

Each venue poses different problems to solve, we find. This major problem was to resolve how to travel over sharp, potentially lethal lava from the breeding ground to the coastal camp in the dead of night. In the pitch darkness, flashlights or torches are not of much use as there are no identifying landmarks. Finally we realise that having a satellite camp is the only solution. We establish a very basic two man tent and mosquito net near the flamingos' breeding lagoon. This satellite camp is used until there is sufficient daylight to enable us to find our way across the treacherous lava to the main camp on the coast.

The flamingos in Sarten have not started nesting we discover, however their feeding and other behaviour could be observed from close quarters. We invariably have to cover ourselves from head to toe to prevent being "eaten alive" by the swarms of mosquitoes. This trip turns out to be very successful in spite of having our three months old baby son with us.

On one of these field trips we are left on the beach to set up camp and the local fishing boat we had hired sails away back to Puerto Ayora, on the Island of Santa Cruz. No sooner have they disappeared over the horizon, than we realise that we have no cutlery or crockery. The box containing it has somehow been overlooked and it is still on the boat. This situation calls for some lateral thinking! How can we eat our food? We have a few saucepans to act as containers so we can still cook. After combing the beach we find a few interesting shaped shells that can be put to use as spoons. We have lemons and grapefruit and once the flesh is eaten from them they are ideal porridge bowls and tumblers. The first aid kit provides spatulas which we use as forks and spoons and for stirring. We are barely coping when the little boat appears over the horizon again. The skipper realised that we were bereft of utilities and he kindly returned to Santiago to bring them to us. This is greatly appreciated.

Interspersed with expeditions to the flamingo lagoons, we are preparing a study of flightless cormorants. Flightless cormorants are found only on the coast of the Island of Fernandina and the northern tip of Isabela. There are believed to be about 800 pairs but numbers fluctuate depending on the temperature of the adjacent ocean currents

from year to year. They are especially vulnerable to oil spills in the area or to the possibility of volcanic activity. Such events have the potential for wiping out the whole colony. Our remit is to compare colonies of cormorants at tourist visited sites with those at non visited sites to see if the breeding success varies.

Fernandina is the youngest of the islands and the furthest west. It comprises a main active volcanic cone which erupted in 1978 while we were in the islands. We set up a fairly primitive camp half way between the two colonies of interest at Punta Espinosa. The latter is a very popular spot for tourists as it is the only place for tourist to view and photograph these endemic birds. The bare lava extrusions are usually crawling with marine iguanas. Darwin's evolutionary ideas are in evidence on Fernandina.

Flightless cormorants are one of 28 types of cormorant and are the only cormorant that has lost the power of flight. They have "tatty" vestigial wings but continue the same behavioural repertoire of spreading them to dry in the sun and wind after a stint of diving in the ocean. Darwin observed these birds and deduced that they had evolved to fit their new environment where there were no predators and ample sea food. Their legs became very thick and strong and their bodies larger and heavier than their cousins.

Two more Ecuadorian Doctoral students from the Catholic university in Quito accompany us on this trip to assist with observations and to obtain data for their biology theses. They carry out observations at the non-tourist visited site and I carry out my observations at the tourist visited site. This entails a walk of about 600 metres and clambering over lava cones and finally sitting for four hours on a boulder as close to the incubating birds as possible without being intrusive.

The flightless cormorants, like many other Galapagos birds carry out a fascinating courting ritual which includes the male carrying a gift of alga or other sea vegetation in his beak and jumping from boulder to boulder as he approaches his mate. Cormorants give the appearance of being very clumsy on land and waddle like ducks. The gift is offers to the sitting or standing mate who takes it in her razor sharp bill and appears to make a fuss of deciding where on the flat nest she will place it. She finally settles on a spot for it and hunkers down while he preens and dries his wings in the sun by stretching them wide.

Some of the main findings from this study are that the females "desert" the nest once the male is capable of caring for the approximately 1.7 young. This happens after about 50-70 days. The sexual dimorphism in cormorants enables the heavier male to fish in deeper waters than the female and catch enough fish for family needs in less time. (4 hours against 5 hours). By the female deserting, the breeding success for the colony overall is increased as she can either start breeding again with another male in a good season or is ready to breed as soon as conditions improve. Our research suggested that there was no significant difference between the breeding successes in the tourist visited site compared to the tourist non-visited site.

We continue working on the islands with flamingos and flightless cormorants as well as running the research station library until we pack up and leave for civilization mid 1979. Our second child, Danielle, is born in England two months later.

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